

Review Article

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Old and New Concepts in Brain Death: A Medico-Legal Overview

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Abstract

Although brain death has been extensively dealt within the contemporary literature, there does exist some ambiguities regarding its definition, clinical criteria, ethical and religious perspectives. The neurological criteria helped in subduing the much talked about issues of whole brain death and brainstem death to a greater extent, but the recently introduced cardiac or circulation death made the issue of brain death more complicated and indeed a conundrum. We would touch upon brain death issues since the terminology was initially introduced till the present day when the cardiac death connivingly made its way as a means of organ procurement in the so called dead patients. This review article is the authors' own perception and understanding of the conundrum of brain death, and should not be misinterpreted as a narrative or a systematic review of the subject. In conclusion, this review aims at filling the void that exists about the criteria for brain death in the contemporary literature.

Key words: Brain Death; Legislation and Jurisprudence; Patient Selection

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Historical perspective

To start with, it would be pertinent to say that during the first half of the last century, the concept of brain death did not exist, and patients were declared to be dead when there was cessation of cardiac and respiratory functions. There were no gadgets and present day tools and acumen to revitalize the pivotal organs i.e. the heart and respiration for a longer period to establish the continuity of life, and thus death would ensue automatically once the heart and respiration had ceased to function.

It was in the year 1952, when Ibsen, an anesthesiologist hailing from Copenhagen used artificial ventilation by iron lung for the first time in a child who had sustained intractable respiratory insufficiency secondary to poliomyelitis, a maiden technique that helped in lowering the mortality from 84% to 21% (1). The use of this ventilator modality sparked the notion of long term ventilation, and a possible means to delay the onset of death for a period of time.

The very first termination of therapy after brain death was established in a boy after having confirmed it by electroencephalography (EEG), and angiography in 1960 (2).

Death used to be commonly considered when there was cessation of heart and lung functions. However, eyebrows raised when the heart function was restarted by the successful defibrillation of a

human heart (3). The revival of the heart rekindled the thought that technology could revamp life in a supposedly dead patient thus slackening the age old concepts that cessation of heart and lung functions always amounted to death.

Bower and Bennett introduced the concept of positive pressure ventilation which later led to the production of the Bird ventilator (4, 5). which served as a milestone discovery saving innumerable patients who would have died if left on their own. Again it became evidently clear that modern technology could help in preventing or delaying death by providing non-stop mandatory ventilation to patients awaiting inevitable death due to respiratory insufficiency.

It was however exceedingly difficult to pronounce the death of comatose patients who had no reflexes, no breathing, and had an isoelectric EEG, but had an active heart that maintained the circulation. According to neurological criteria the patient was dead but a beating heart prevented the team to declare the patient's death. It was thus decided to switch off the respirator and thus declare the death of the patient (6).

This and other similar patients raised the dilemma of the death of the nervous system which was difficult to be labelled as death of the patient as the heart worked without fail. These cases who were comatose and this so called scenario was termed coma depasse or beyond coma (7). This state

although declared as death but fell short of an unequivocal death as perceived by all. Schwab et al. did not feel at home with this vague description of death and thus propounded the electroencephalographic idea to establish death of the nervous system (8). To establish death's criteria, he provided his landmark triad of criteria: 1) Fixed and dilated pupils, no elicitable reflexes, and no spontaneous movements; 2) apnea, and 3) isoelectric EEG. All those individuals who met these criteria could safely be declared as dead despite a fully functioning heart.

In 1957, an anesthesiologist asked Pope as to whether it was permissible to terminate mechanical ventilation in frankly hopeless individuals (9).

To provide a religious backing to the physicians' dilemma in dealing with hopeless cases, Pope Pius XII passed a decree in the year 1957 that physicians were at liberty to withhold "extraordinary" treatment in cases that were deemed "hopeless" (10). This decree although could help in appeasing the existing worries of the physicians during that era, but the word "hopeless" lacked scientific backing and thus could be construed and comprehended differently upon the physicians' whims and understanding of the terminology.

Irreversible coma, whole brain death and brainstem death

Although Christian Bernard's world's first successful human transplant was a historical and a giant leap in medicine (11), nevertheless, it made a lot of hue and cry which was followed by an authenticated report by an ad hoc committee at Harvard Medical School that provided a definition of death based and grounded on neurological criteria. The architect and leading anesthesiologist Henry Beecher in the ad hoc committee was of the opinion that their main purpose was to "define irreversible coma as a new criterion for death" (12).

The Harvard definition was largely accepted but confusion still prevailed and some remained highly skeptical as the boundary between life and death was neither explainable nor digestible. Later on, it was felt that the Harvard committee's report however fails to provide an improved understanding of the nature of the death (13).

Then the faculties of the United Kingdom (UK) came into the arena and propounded the idea of brainstem death on the grounds that as both consciousness and respiratory functions originated in the brainstem, loss of brainstem functions can be regarded as death as perceived and comprehended by all people (14, 15). An isoelectric EEG which

formed a fundamental pillar in diagnosing brain death in the United States (US) was eliminated altogether from the U.K criteria and these further widened controversies in countries in this part of the Atlantic and in those across the Atlantic. Thus patients with brainstem death criteria but with preserved cortical activity as revealed by EEG findings were considered to be dead in the UK but alive in the US (16).

Declaration of death (brain death) employing the brainstem criteria raises an ethical issue that it does not take the concept of the total brain or whole brain death into consideration. Who knows that these patients might open their eyes and recognize the people around them if deep brain stimulation is applied (17). The ambiguity is further strengthened when the highly skeptical people about the brainstem death floated the idea that the whole concept of brain death was introduced explicitly for utilitarian purposes.

Apart from major concerns with the brain death definition among different societies and cultures, a stark difference exists on either side of the Atlantic about the formulation of brain death. In the US, the formulation of "whole brain" is upheld which comprises of loss of all functions of the brain including the brainstem, whereas in the UK, the concept of "brainstem" prevails which requires only the demonstration of the irreversible loss of brainstem functions (18).

It is to be remembered that brain death has been widely described as the demonstration of irreversible coma along with a loss of brainstem reflexes and irreversible coma (19).

Contrary to whole brain death, the diagnosis of brainstem death requires irreversible loss of consciousness and irreversible loss of the capacity to breathe. Its protagonists propound the idea that brainstem death is synonymous with whole body death because the pivotal components that are needed for life such as consciousness, respiration and circulation are all located in the brainstem (20); and brainstem death can both logically and scientifically be declared as death of the whole body. To corroborate this concept, destruction of the brainstem reticular core leads to a loss of consciousness in laboratory animals. This observation and similar other observations sparked the concept of the ascending reticular activating system (ARAS). Although this concept that structures in the brainstem regulate consciousness still holds true, the ARAS is no longer regarded as a monolithic unit, nor is it restricted to the classically defined nuclei in the brainstem. Reticular formation that is considered

to control consciousness can well extend beyond the medulla and pons to structures in the mesencephalon and even to portions of the diencephalon. Thus, arousal or consciousness is a highly complex phenomenon and cannot be ruled out by simply focusing on the brainstem death criteria. Consciousness is not a unitary phenomenon but is in fact derived from many neurological sources and thus should undergo extensive scrutiny before it is labelled as irreversible loss of consciousness.

Brain-dead patients have shown levels of somatic integration which had persisted for some time and such findings fail to equate brain death to the death of the individual (21).

Although brain death has been accepted for almost half a century, some skepticism does prevail regarding determination of death by the neurological criteria (22).

The diagnosis of brain death is customarily made on a clinical examination coupled with an examination of brainstem function; however, in the presence of confounding factors or in cases where a suspicion exists, ancillary tests to document cerebral circulatory arrest are used in helping the clinician to clinch the final diagnosis (23).

Ancillary or confirmatory tests are required if and when the clinical diagnosis of brain death is in doubt, or because of the instability of the patient to undergo an apnea test (24, 25).

The EEG frequently employed as a confirmatory test can show both false positive and false negative errors, and moreover the EEG summates potentials from the cerebral neocortex and does not exhibit any potentials from the subcortical structures such as brainstem or thalamus. Thus the EEG could be isoelectric in the presence of viable neurons in the brainstem. Thus it appears that conclusive findings regarding the colloquially mentioned death or human death can only be obtained if the brainstem criteria of death are merged with an isoelectric EEG. That would help us in our correct decisions regarding the declaration of death.

Medical and legal considerations of brain death

Brain death is colloquially defined as loss of all functions of the brain, including the brainstem. Three essential components of brain death include coma, absence of brainstem reflexes, and apnea (26). In order to arrive at a subtle diagnosis of brain death, it is pertinent to exclude confounding factors such as shock, hypotension, hypothermia (Temperature <32°C), drugs that are incriminated to alter neurologic, neuromuscular function and electroencephalographic testing such as anesthetic

drugs, neuromuscular drugs, methaqualone, barbiturates, benzodiazepines, high dose bretylium, amitriptyline, meprobamate, trichlorethylene, and alcohol, etc. Other maladies such as brain stem encephalitis, Guillain-Barre syndrome, and encephalopathy associated with uremia, hepatic failure and hyperosmolar coma, and finally severe hypophosphatemia should be ruled out before clinching the final diagnosis of brain death (27).

However, if a neurological and clinical examination is performed, it is mandatory to repeat the examination after a period 1-24 hours depending upon the discretion of the center in case of adults, and in children an observation period of 12-48 hours depending upon age has been recommended to give the final verdict of brain death (28, 29). In some of the protocols, ancillary tests such as EEG, cerebral angiography, nuclear scanning, transcranial Doppler ultrasound, computed tomography (CT) angiography, and magnetic resonance angiography have been used to shorten the observation period. EEG, nuclear scan, and cerebral angiogram tests have been prioritized these days and 4-vessel cerebral angiography has been traditionally recognized as the gold standard. Nevertheless, these tests do not necessarily confirm clinical brain death and cannot serve as substitutes for neurological examination (21, 30). At times brain death is declared quickly for the fear of organ damage and thus their non-procurement for donation. However, it is imperative that declaration of brain death should preferably be conducted taking into full considerations of all the legal and medical aspects.

The new era of cardiac or circulation death

With a final consensus still lacking regarding brainstem death and whole brain death, and the scarcity of organ shortage, a new idea has been expounded as donation after cardiac or circulation death (DCD) or circulatory determination of death (31).

In these lately introduced criteria of death, death is declared after cessation of circulatory /respiratory function. The DCD does not take into consideration or in fact does not fulfill the neurologic death's criteria before withdrawal of the ventilator support (32).

The circulatory criteria of death are non-compliant with the definition of death in most of the religions, and thus stand premature and hard to accept. The proponents of DCD justify the circulatory criterion of death philosophically by arguing that there is no intent or action to attempt resuscitation in a

patient consenting to organ donation when the spontaneous heart beat ceases, even though the heart can be restored back to normal coupled with recovery of brain functions. Several criticisms have been leveled on the DCD program such as instantaneous decisions on the part of the transplant teams to procure organs without ascertaining the state of irreversibility, insufficient efforts undertaken to save the donors and removal of life support in order to retrieve organs for organ donation (33-35).

It has also been propagated that the seemingly ceased physiological functions of the cardiovascular, respiratory and neurological systems are reversible at the time of procuring organs from the non-heart-beating donors, and furthermore, the hearts procured after circulatory arrest of 2-5 minutes or even more than that regain normal function in the transplant recipients. The heart can regain functions even after 10 minutes of cessation of activity. The major ethical issue with the DCD is that the support systems are removed by the attending care provider and death is declared after cessation of circulatory / respiratory function. In contrast, in the brain-dead patients, organs are typically recovered by the transplant team while the patient is under hemodynamic and ventilator support. Such a wide difference in the declaration of death obviously raises questions of insurmountable dimensions that are in a cloak of absolute darkness.

Limitations

As the laws in different countries are totally different and so are the taboos, cultures and religions, we did not take into consideration these aspects which could be considered as a limitation of the study. Moreover, our main aim was to unveil the medico-legal aspects of brain death in its totality as depicted in the title and had no intention of dwelling on the religious aspects surrounding the domain of brain death.

CONCLUSIONS

In conclusion, it appears that a void exists as far as definition of brain death is being conceived at present. The brain stem death and whole brain death have their own proponents but a consensus regarding single criteria is lacking. The newly evolved criterion of cardiac death has further shrouded the concept of death in general and that of the brain death in particular. The so called cardiac death totally negates the concept of brain death and upholds the notion that within a short span of 2-5 minutes or even lesser than that in

some centers, the organs can be procured and transplanted in the recipients. This trend and a revolutionary introduction of cardiac death to meet the growing demand of organs for transplantation raises some obvious ethical issues that have neither being unveiled nor touched upon to appease the concerns of intellectual vanguards and the religious bodies. How is it possible that a heart that had stopped beating a couple of minutes earlier starts beating again with all the vigor and strength when transplanted in the recipient? Who can unequivocally guarantee that such a step to promote organ transplantation does not amount to passive or perhaps active euthanasia?

To arrive at a more conclusive and a globally accepted verdict, there is a dire need to conduct a skull session of all the stalwarts and eminent scholars in the field of death and brain death issues to issue another ad hoc declaration similar to the one that appeared in the second half of the last century. Such a scientific declaration would prove to be a valuable document for all and sundry and would naturally appease and allay the growing anxieties of all strata of the societies in general and the academia in particular.

Although the introduction of neurological criteria regarding brain death could earn muted praise but the lately announced DCD criteria dampened the existing hopes about the criteria for death and made it a mystery rather than clearing out the criticisms attached to this stigma. The introduction of the DCD criteria seems to be at the pinnacle of an illogicality and irresponsibility and is totally reckless and ill-founded. Till the time when a consensus is reached, we should exercise the utmost restraint in declaring death based on the DCD criteria, because under no circumstances and existing laws does the DCD criteria meet or qualify brain death or for that matter whole body death criteria.

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AUTHORS' CONTRIBUTION

ZH-K introduced the concept of the idea and prepared the manuscript. M-DT helped in literature search. MM helped in References search.

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